

Light Duty Vehicle Markets & E85: Theory, Econometrics & Modeling

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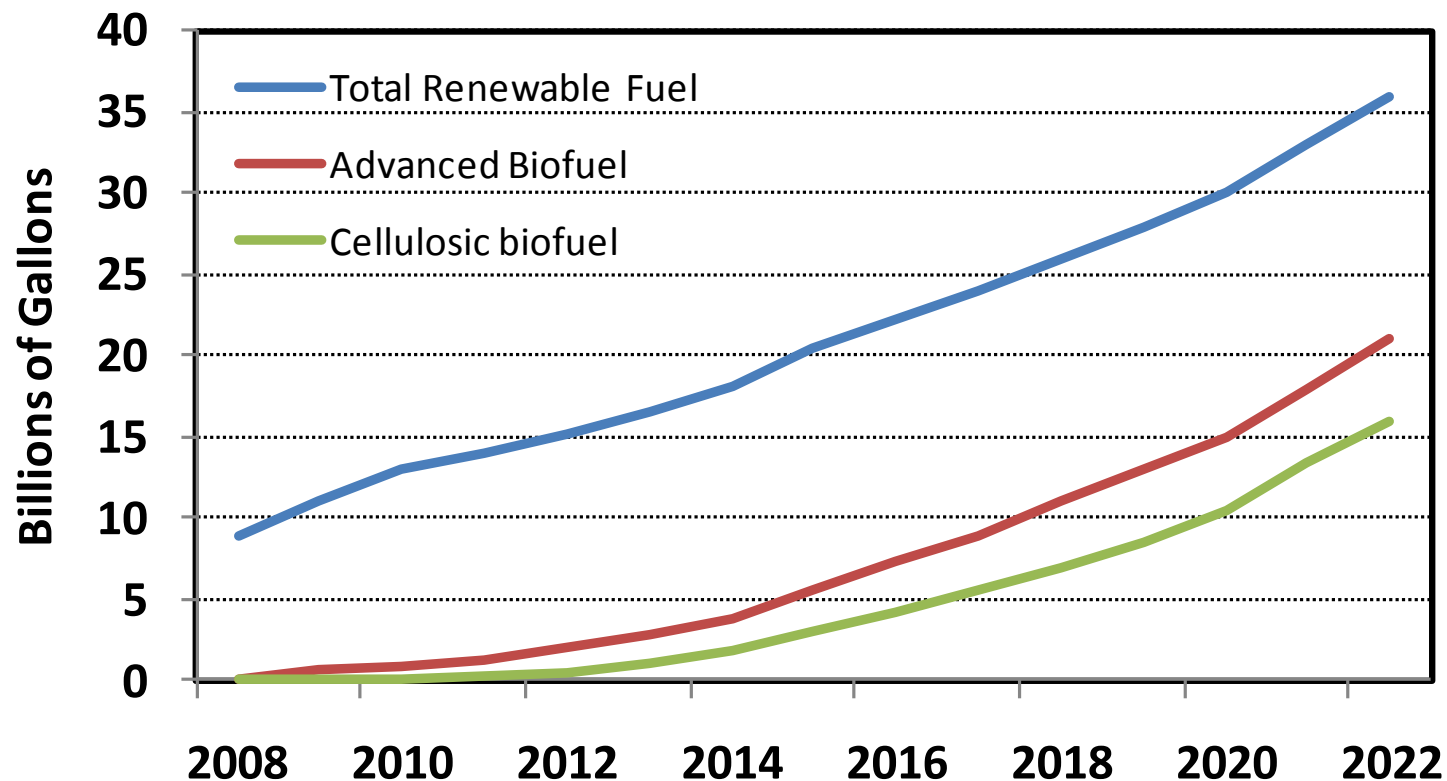
Energy Information Administration

Washington, DC



The Renewable Fuels Standard 2 calls for 36 billion gallons of renewable fuel use by 2022. What role can E85 play?

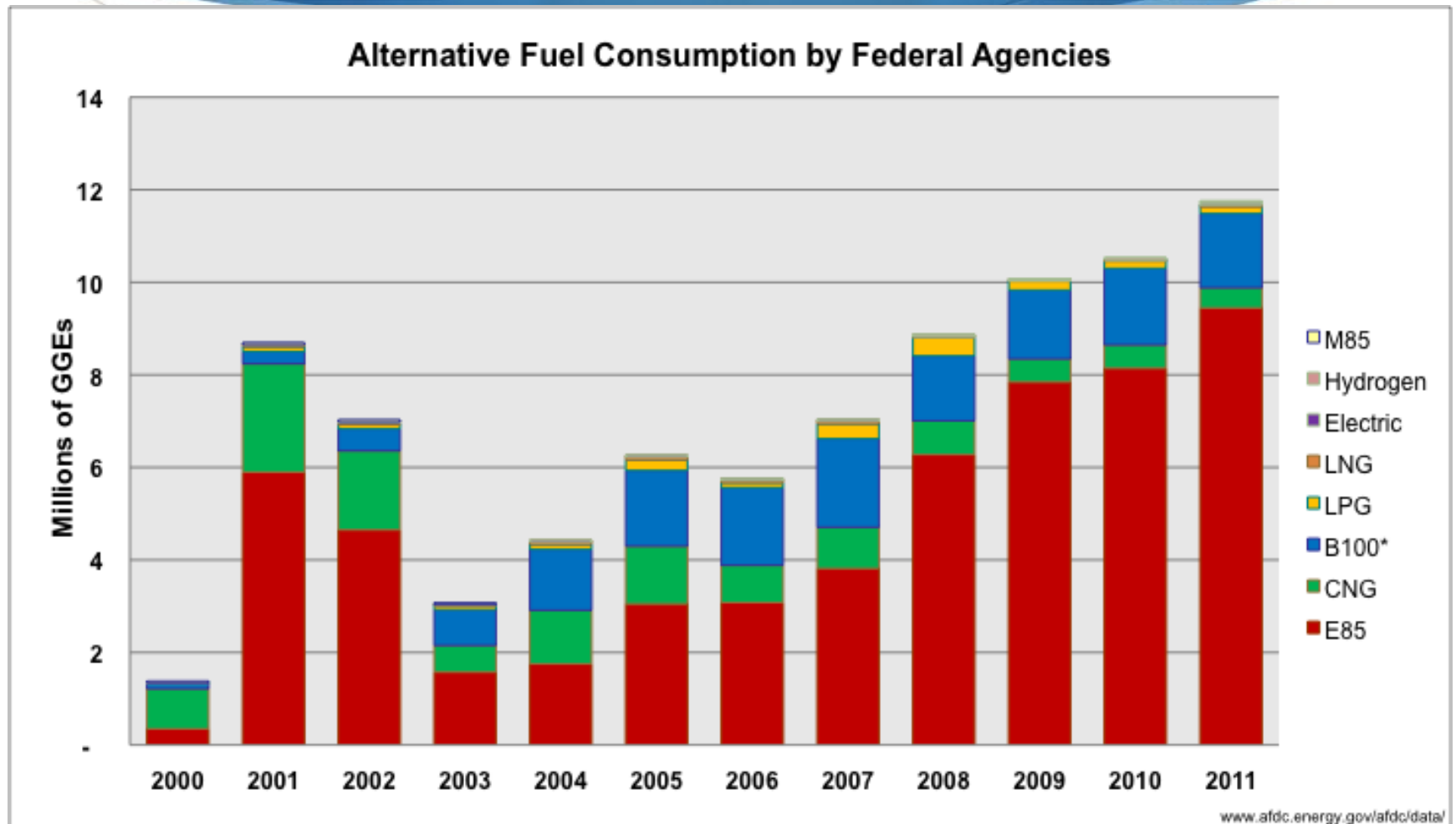
EPA Renewable Fuels Volume Requirements



Increasing ethanol use to 36 billion gallons is a key objective of the Energy Independence and Security Act of 2007. How important will availability of E85 be to achieving that goal?

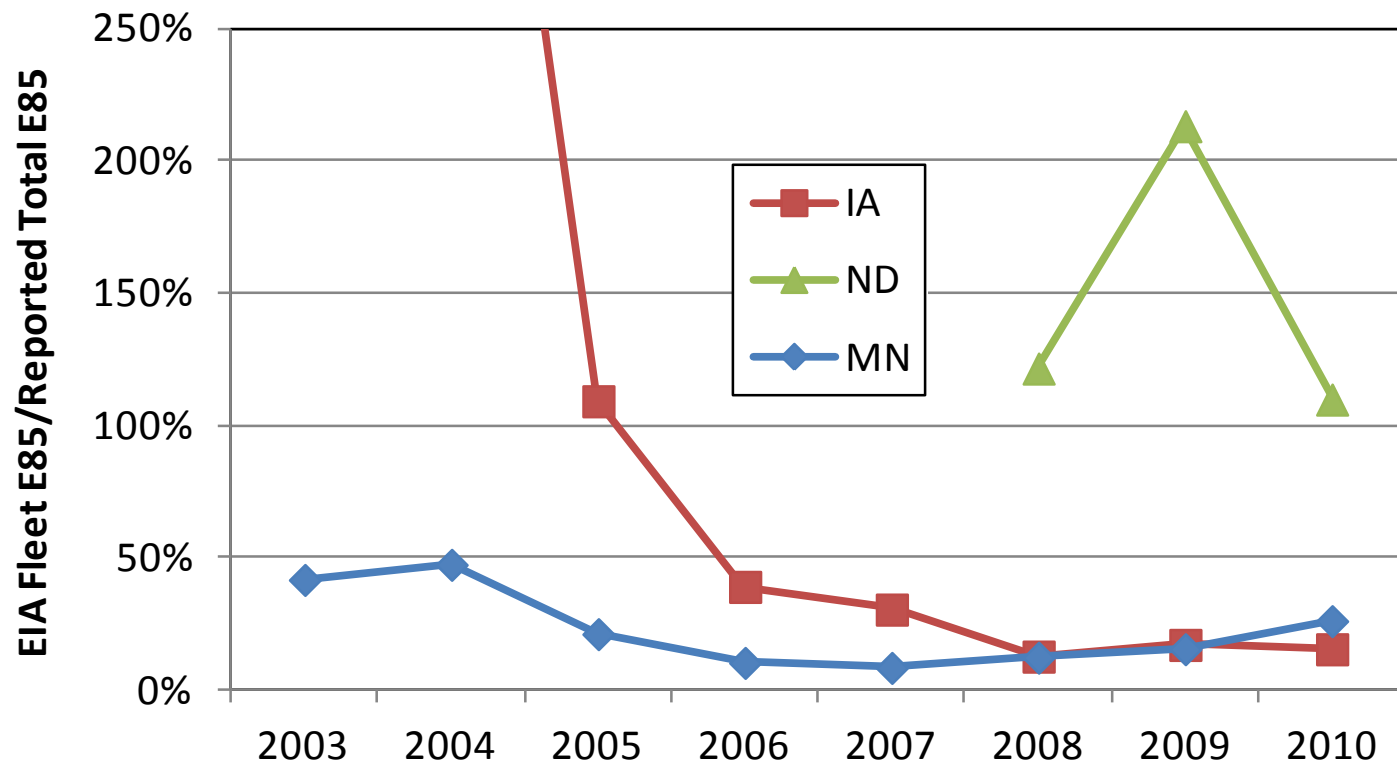
- ◆ Low level ethanol blends may “max out” and E85 may have to make up the difference.
- ◆ How sensitive is E85 demand by FFV owners to:
 - ◆ The prices of E85 and gasoline?
 - ◆ The availability of E85 at public, retail outlets?
- ◆ There are serious data issues to consider.
 - ◆ **Available US data is for fleet rather than total E85 use**
 - ◆ **State data are available for MN, IA and ND.**

A substantial quantity of E85 is consumed by government fleets in response to mandates.

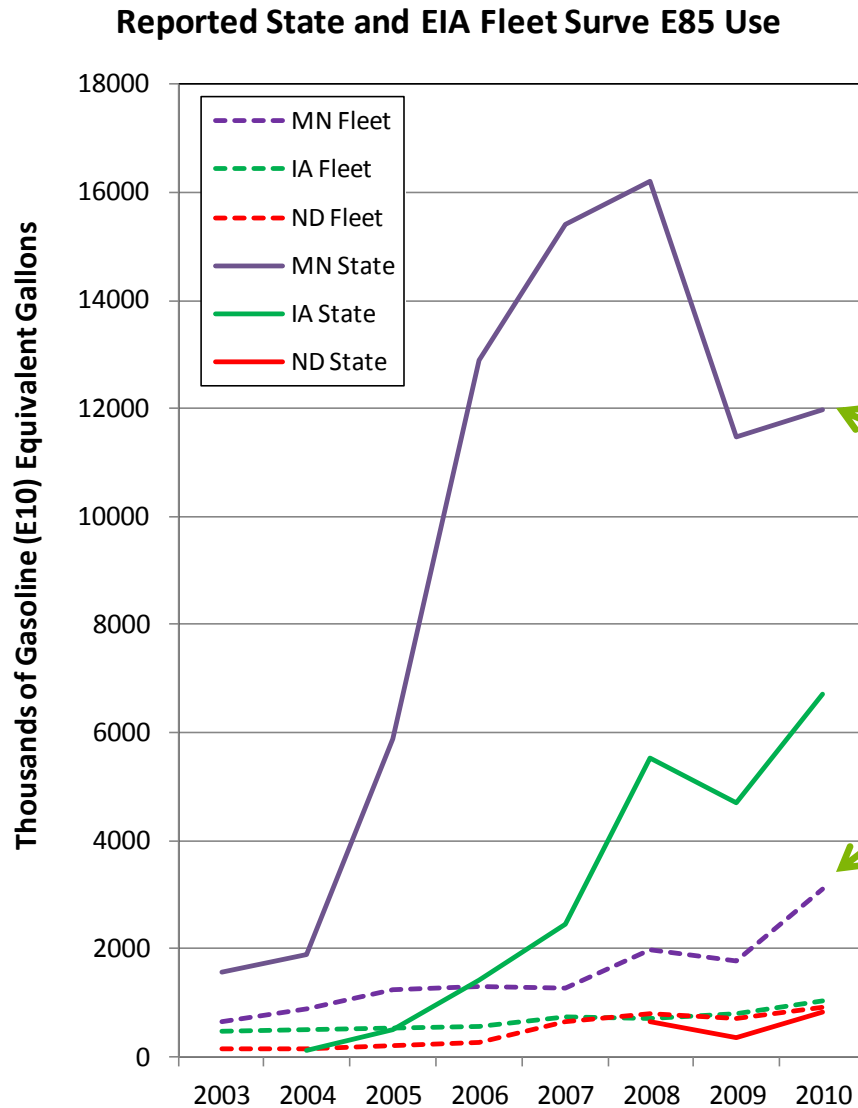


A very large fraction of the E85 consumed to date in the U.S. has been consumed by fleets vs. individuals.

Fleet E85 Sales Relative to Reported Total Sales



No study to date has addressed the potential bias caused by combining fleets' and individuals' E85 use.



Changes in fleet use are a likely source of bias in estimating the price sensitivity of individual motorists.

The Minnesota data was previously analyzed by Greene (2009) and Anderson (2006 & 2011).

- ◆ Anderson (2006), found a price elasticity of about -3 assuming E85 price is exogenous to MN demand.
 - ◆ Up to -13 assuming simultaneous determination of price and quantity of E85.
- ◆ Anderson's 2011 analysis (also based on MN data from 1997-2006) implies a price elasticity of approximately -4.
 - ◆ 12%-14% decrease for a \$0.10 increase in E85 price;
 - ◆ 1% increase in E85 stock leads to a 0.05%-0.10% increase in demand;
 - ◆ 1% increase in number of stations leads to a 0.0-0.1% *decrease* in E85 demand.
 - ◆ **Preferences for ethanol are heterogeneous.**

While total sales of E85 and the number of FFVs are observed, sales of gasoline to FFV owners are not.

$$E_t = \frac{G_{gt} + rG_{et}}{N_t}$$

$$s_{et} = \frac{rG_{et}}{E_t N_{FFVt}}$$

E = average energy services per vehicle in gallons of gasoline (G_g) equivalents

r = energy content of a gallon of E85 (G_e) relative to gasoline

N = number of light-duty vehicles on the road in period t

s = share of energy services purchased as E85 by FFV owners

A simple logit choice model is used for estimation, in which the value of fuel availability is a nonlinear function of the fraction of stations (f) offering E85.

$$U_e = A_{0e} + A_{1e}P_e + A_2 \exp(A_3 f) + A_{4e}X$$

$$s_e = \frac{\exp(U_e)}{\exp(U_g) + \exp(U_e)} = \frac{1}{1 + \exp(U_g - U_e)}$$

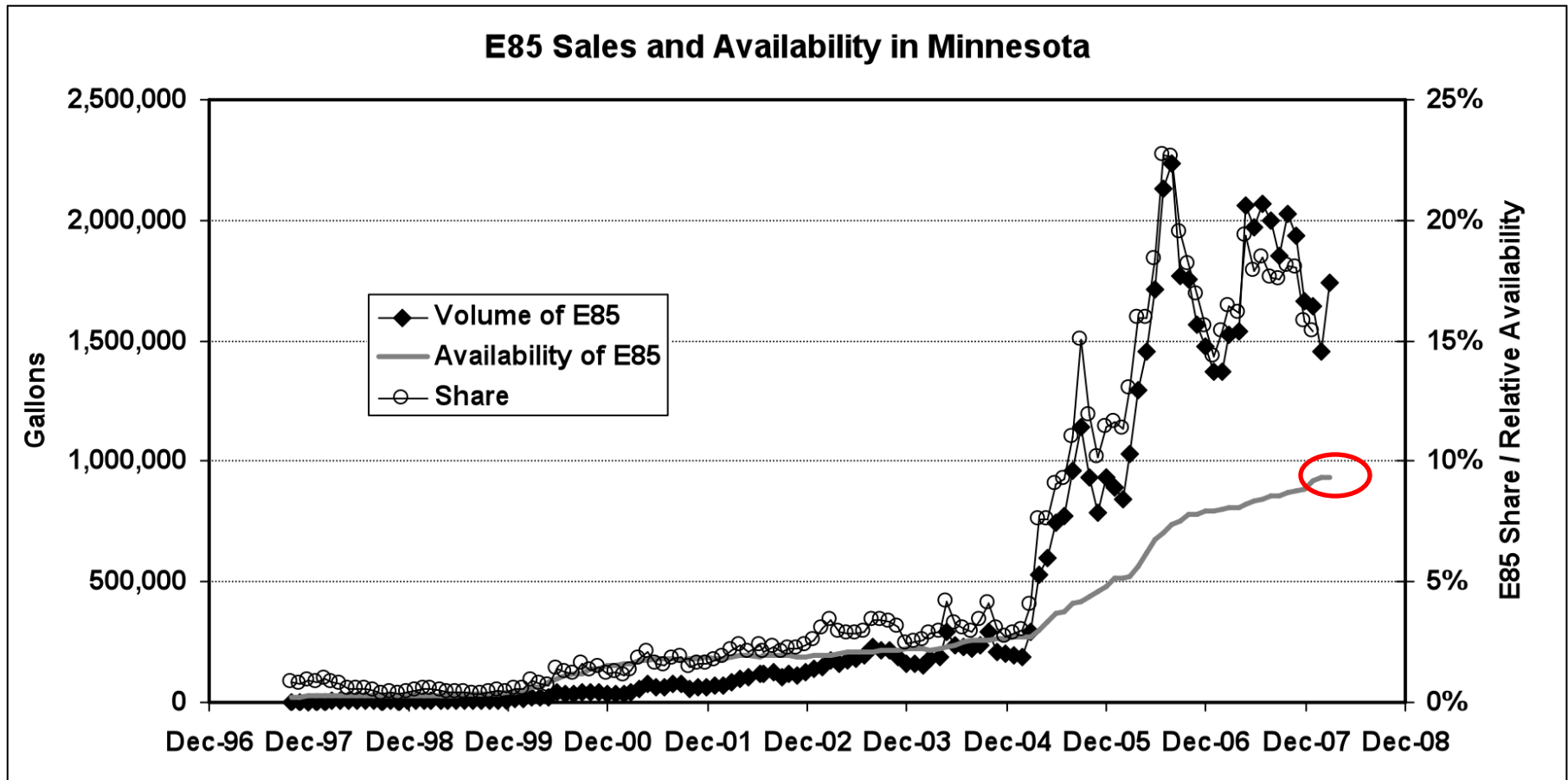
$$\ln\left(\frac{1}{s_e} - 1\right) = U_g - U_e$$

f = fraction of stations offering E85

U_i = utility index for fuel i

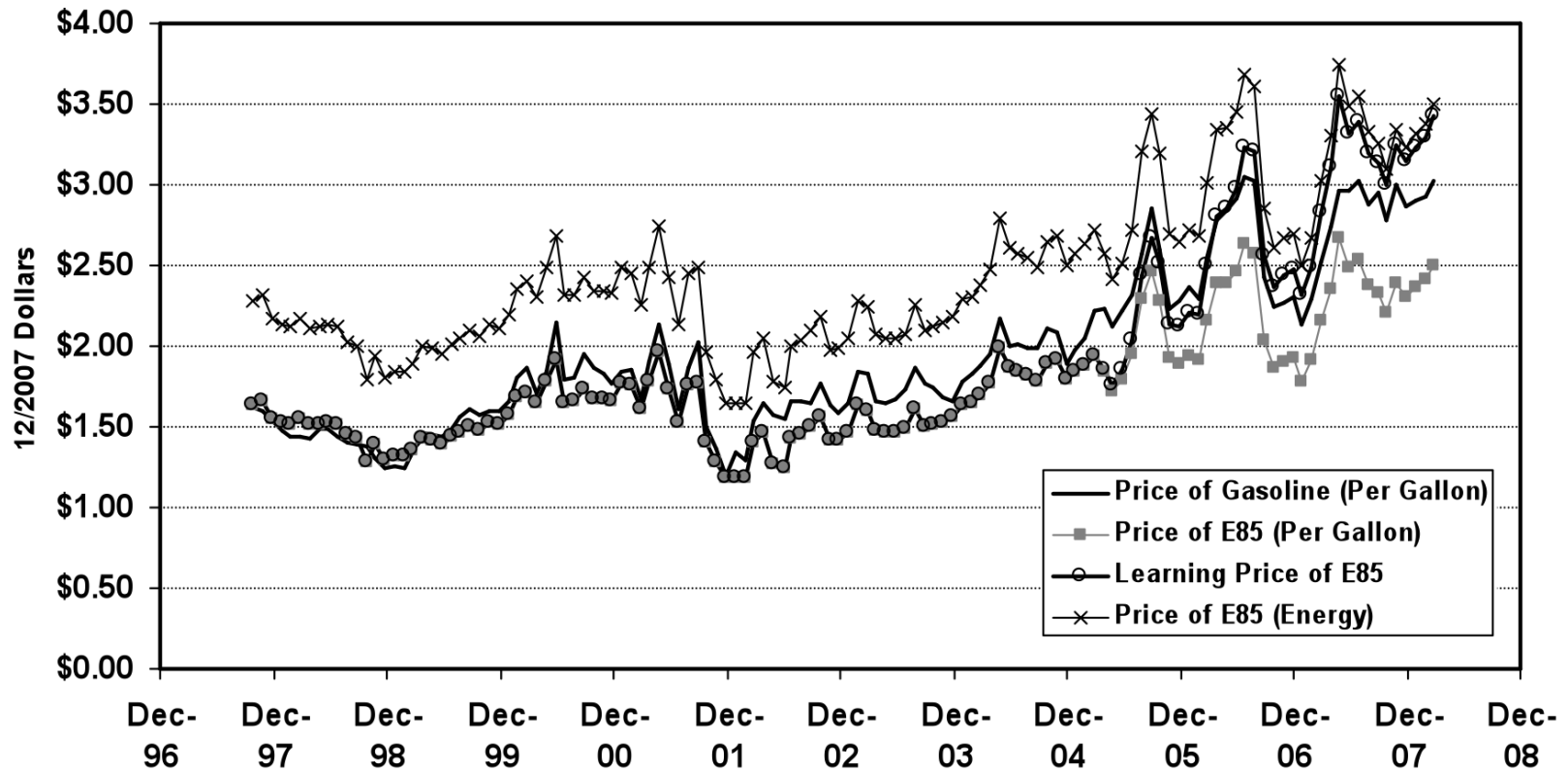
P_i = price of fuel i per gasoline gallon equivalent

Using data from Minnesota through 2007, Greene (2009) found price elasticities ranging from -2 (OLS) to -4 (2SLS).

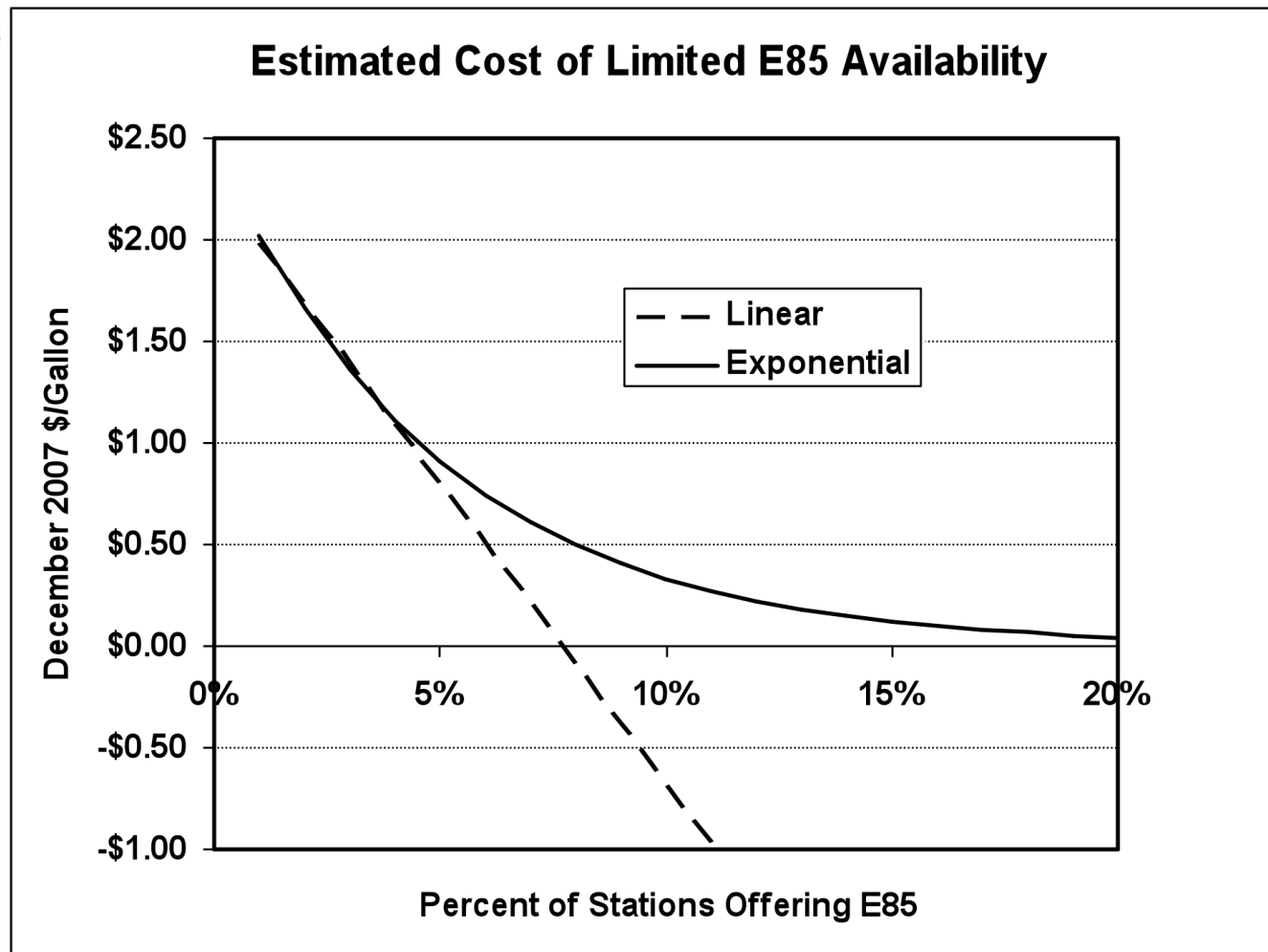


It appeared that motorists were “learning” about the lower energy content of E85 “by burning”.

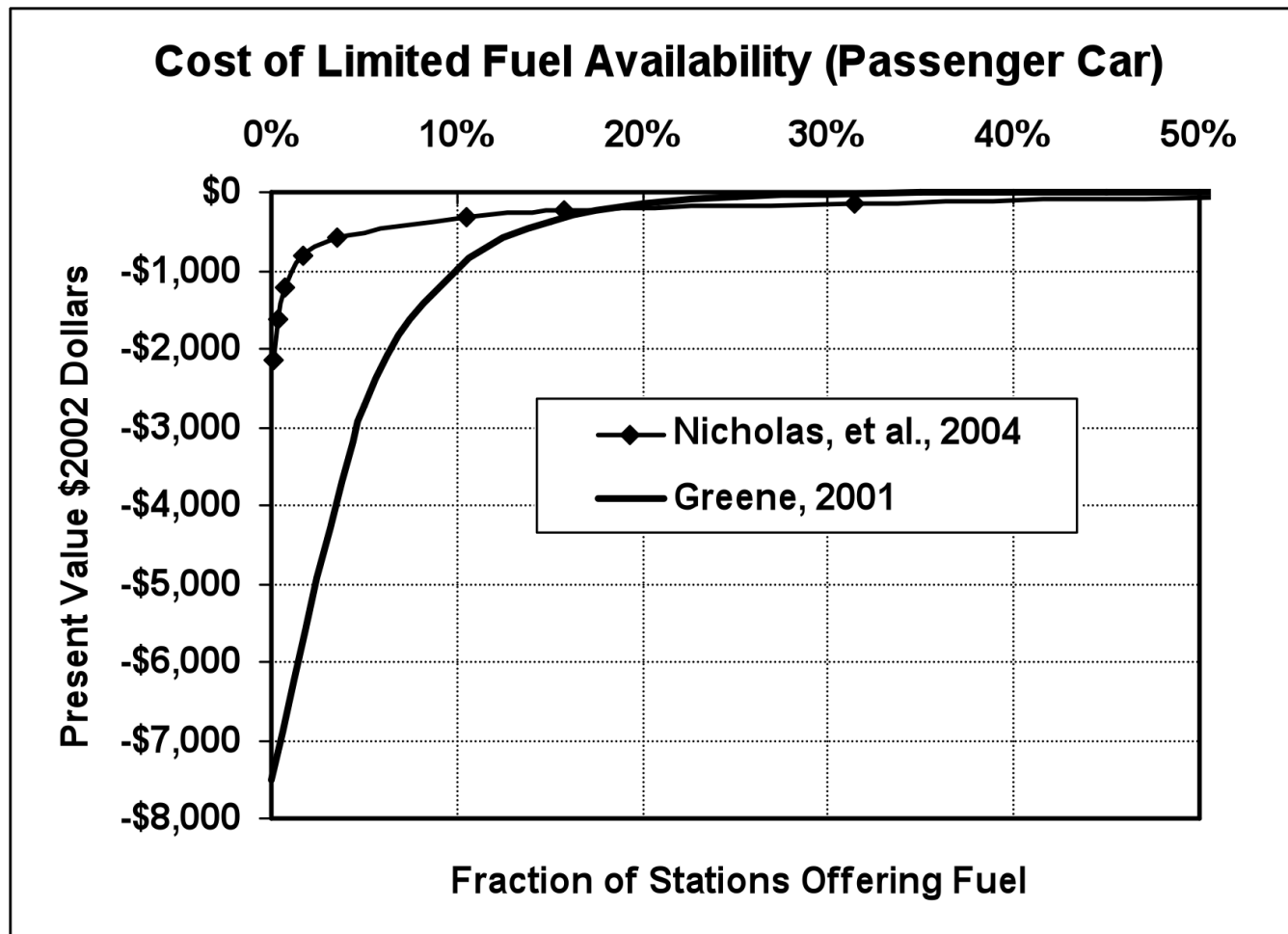
Prices of E85 and Regular Gasoline in Minnesota



For the period in question in Minnesota, E85 availability approached but did not reach 10%. Over this range both the linear and exponential functions imply the cost of limited availability decreases rapidly.

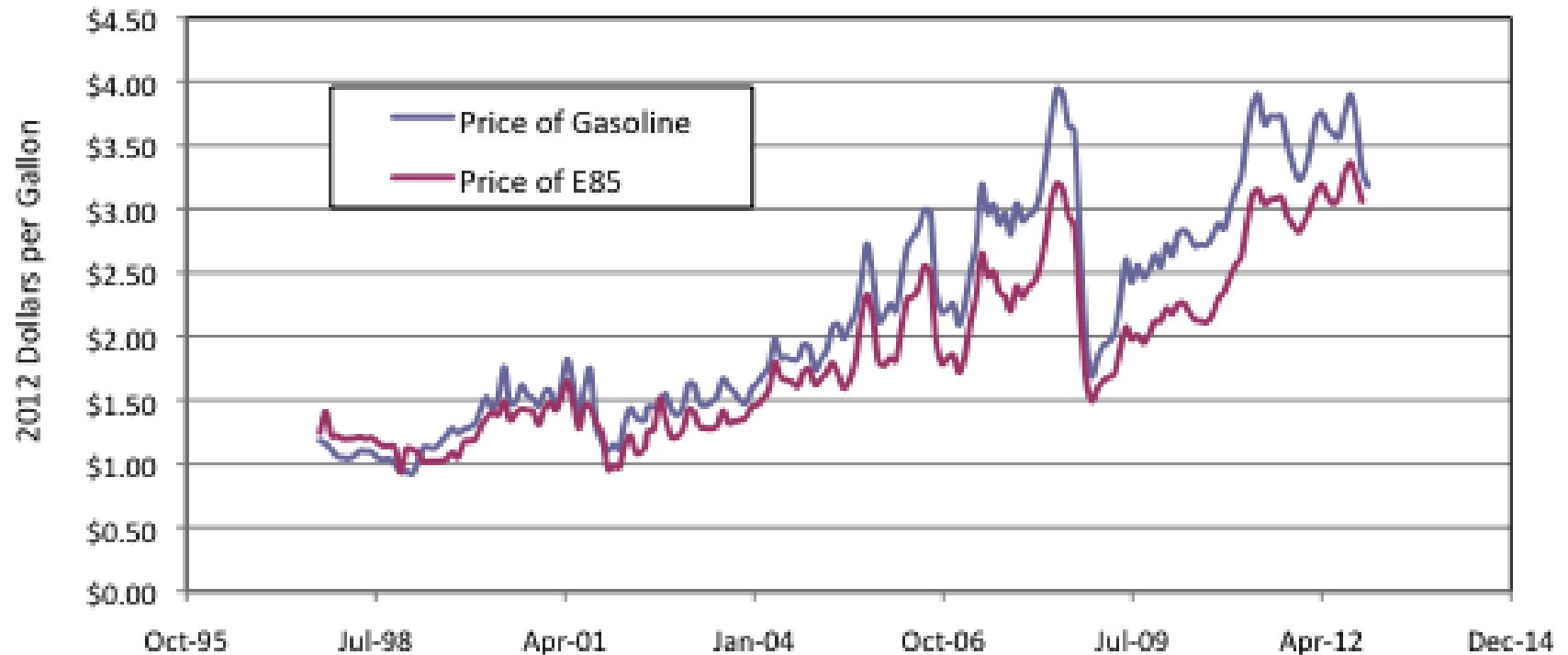


Previous research suggests that for alternative fuel vehicles, availability becomes acceptable when 10%-20% of retail stations offer the fuel.

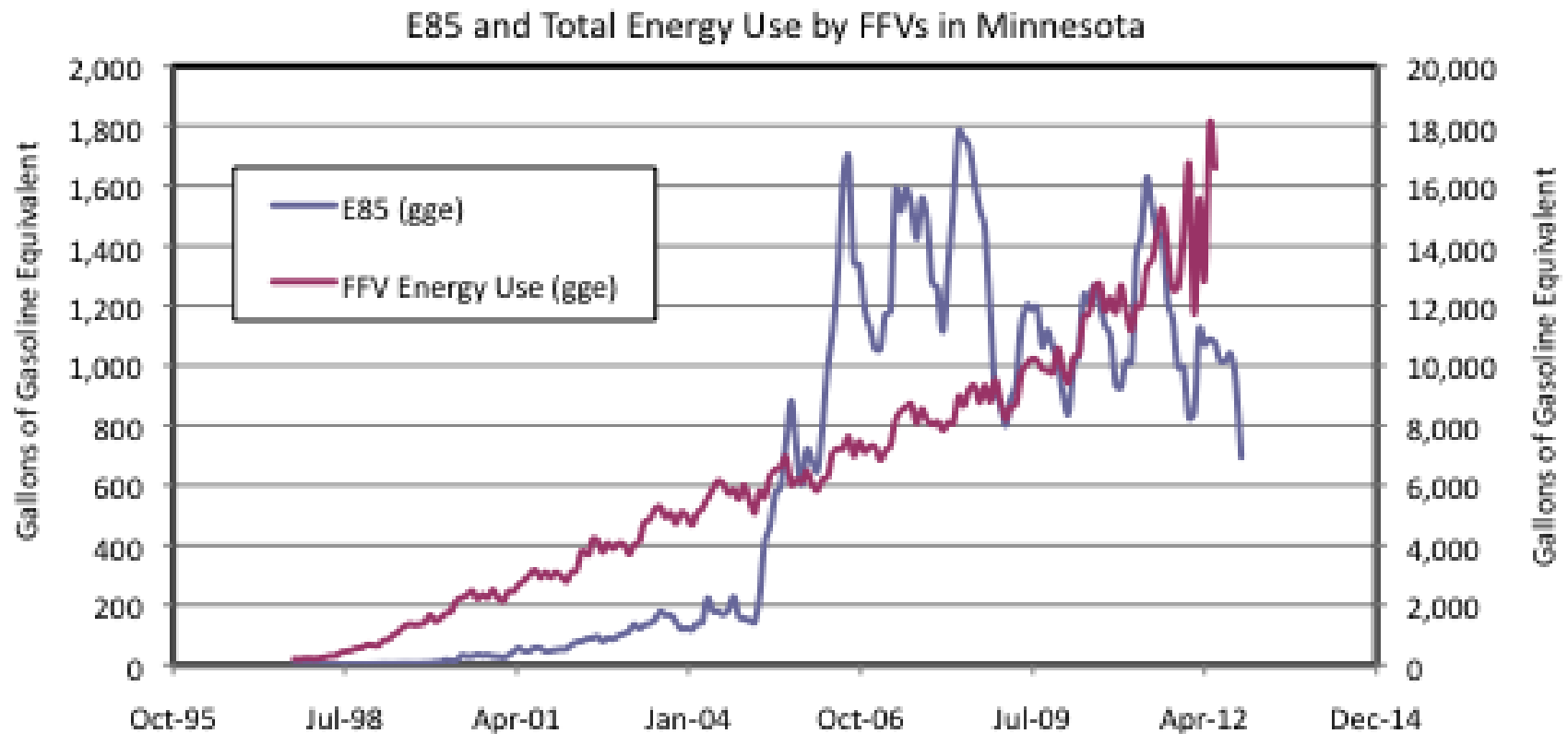


An additional 5 years of data are now available, plus time series from Iowa and North Dakota.

Prices of E85 and Gasoline in Minnesota

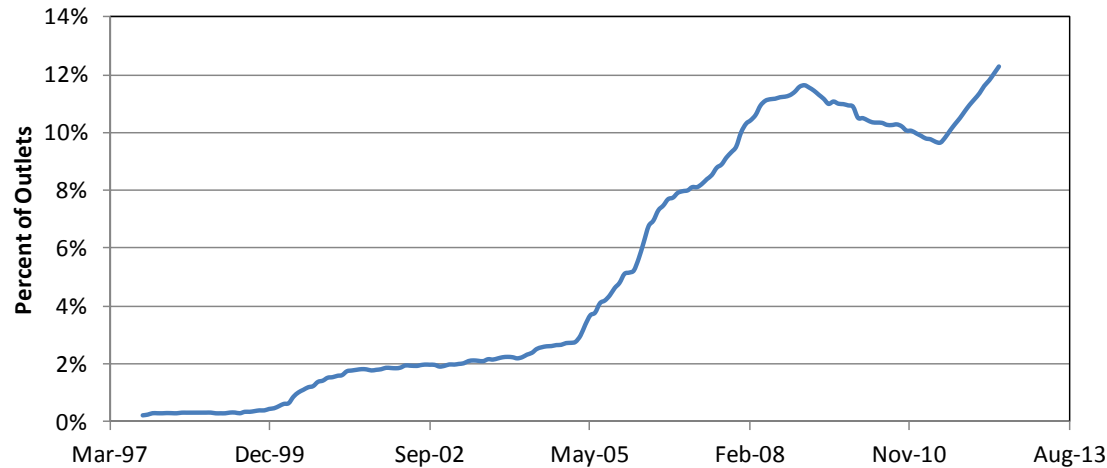


In Minnesota, although E85 grew to about 10% of gasoline use (energy equivalent) from 2005 to 2008 its share has since declined.

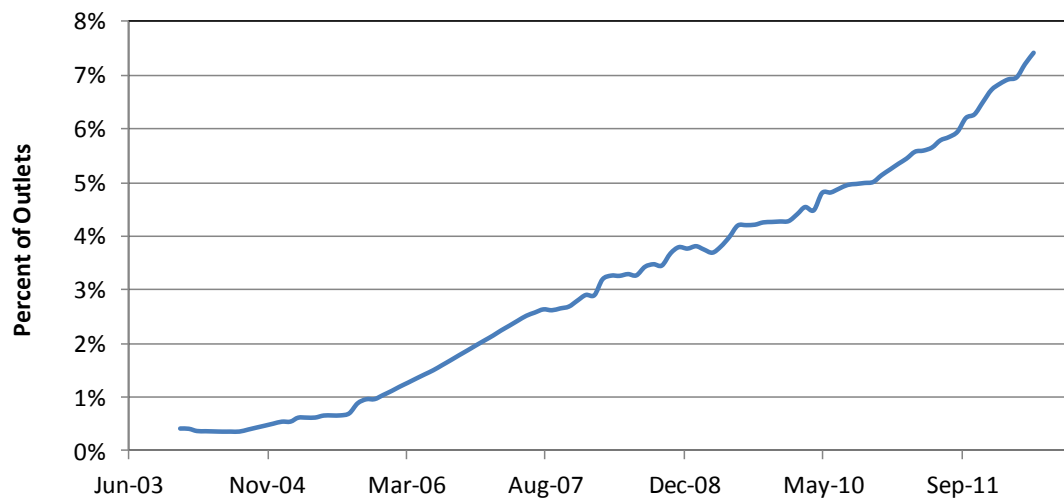


The number of refueling outlets increased in all three states, reaching the vicinity of 10% of total refueling stations.

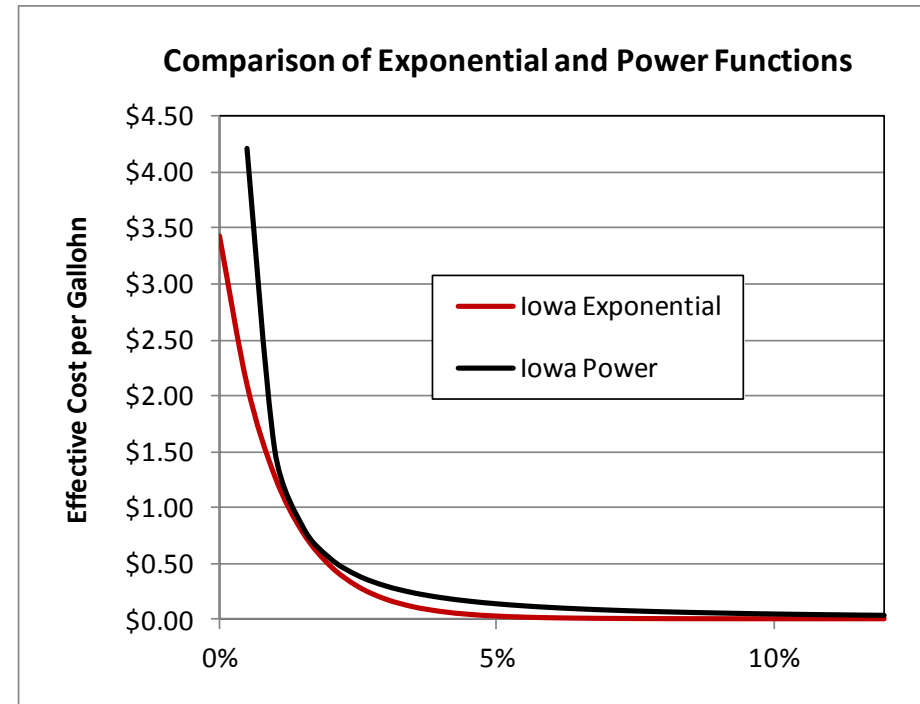
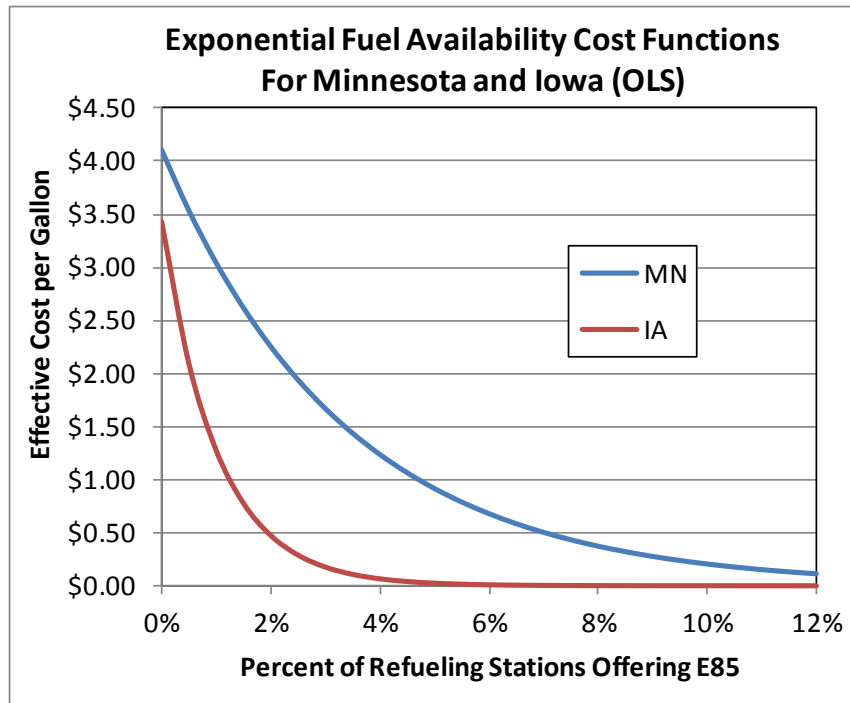
Fraction of Refueling Stations Offering E85 in MN



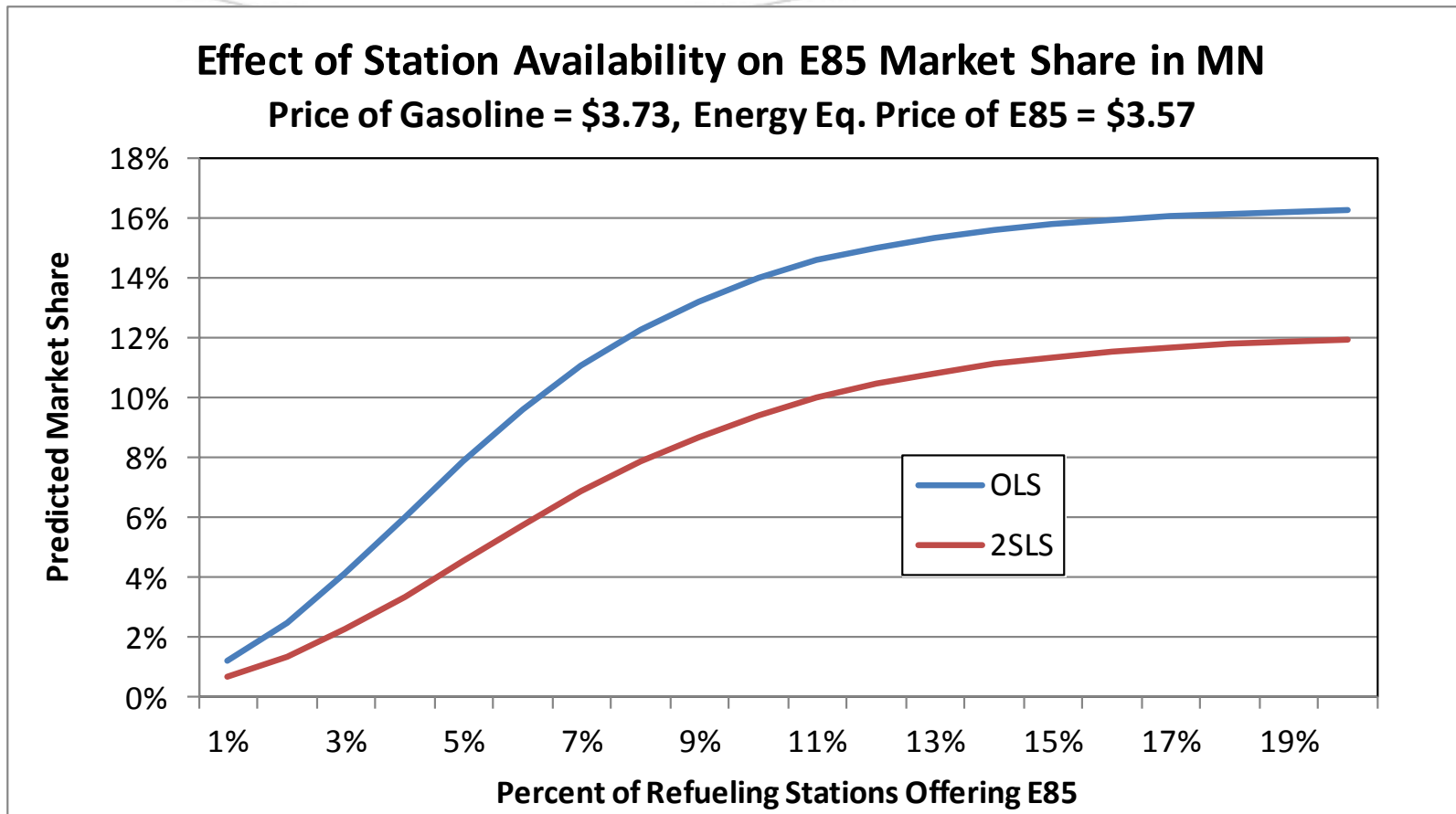
Fraction of Refueling Stations Offering E85 in IA



The reduced sensitivity to fuel availability in Iowa may be due to a larger fraction of fleet purchases of E85. Choice of functional form was less important.



The Minnesota estimates indicate that at about 10% of stations, availability is a less important barrier.



Minnesota's experience sheds some light on the importance of fuel availability and price sensitivity of E85 choice by FFV owners.

- ◆ The cost of limited availability is substantial at very low levels but decreases rapidly as availability approaches 10%.
- ◆ Suggests that strategies that concentrate E85 availability (up to 10%-20%) in a few regions may be more successful than a national strategy with the same number of stations.
- ◆ There are two populations of E85 purchasers with very likely different sensitivity to fuel price.
- ◆ Whether choice of E85 by FFV owners is very price elastic (-4) or extremely price elastic (-10) depends on estimation method and is likely influenced by fleet %.
- ◆ FFV owners appear to have learned the difference between volume and energy content.

THANK YOU.